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MONETARY POLICY UNDER EXCHANGE RATE FLEXIBILITY*

Rudiger Dornbusch

Number 228

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INTRODUCTION

The continuing depreciation of the dollar stands out as one of the big policy issues. It has started to impinge on US monetary policy, it influences the chances for international commercial diplomacy and it is enhancing the move toward European monetary integration. Above all it leaves most observers, with a puzzle as to the causes of the ongoing depreciation.

This paper will, of course, not resolve the puzzle. It rather attempts to lay out the basic analytical framework that has been developed for the analysis of exchange rate questions and to relate it to the question of monetary policy. Part I concentrates on the development of the relevant theoretical framework. The main points to be made here are: (i) exchange rates are primarily determined in asset markets with expectations playing a dominant role. (ii) the sharpest formulation of exchange rate theory is the "monetary approach", Chicago's quantity theory of the open economy, (iii) purchasing power parity is a precarious reed on which to hang shortterm exchange rate theory, (iv) the current account has just made it back as a determinant of exchange rates.

In Part II we review the main strands of empirical research on exchange rate determination. The review concentrates mainly on the monetary approach where work has been quite plentiful, but also looks at some alternative formulations.

Part III pulls together these elements to form some conjectures about the

* Helpful discussions with Jeffrey Frankel, Jacob Frenkel, Stanley Fischer and Michael Rothschild and financial support from the NSF are gratefully acknowledged.

working of monetary policy under flexible rates and about the dollar depreciation. In particular we draw attention to the trade-off between increased net exports and the inflationary impact induced by a depreciation.

The topic covered in this paper has received an extraordinary amount of professional attention in the last few years and much fruitful research has been accomplished. The fine surveys by Isard (1978), Kohlhagen (1978) and Schadler (1977) will place our sketchy review in the perspective of the literature and the books by Black (1977) and Willett (1977) help relate our topic to the ongoing policy discussions.

I. THEORY

In this part we review the main strands of exchange rate theory. We start off with two rock-bottom models that, in an oversimplified manner perhaps, represent exchange rate theory as viewed by the person in "the Street". These models, purchasing power parity and a balance of payments theory of the exchange rate, each contain of course more than a germ of truth and thus serve as a useful introduction to our review.

We proceed from there to more structured models that emphasize macroeconomic interaction or the details of asset markets. These theories can be described as asset market theories of the exchange rate. Extensions of these models are then considered in an effort to add realism. These extensions deal with expectations, questions of dynamics and of indexing and policy reaction.

1. Purchasing Power Parity and the Quantity Theory:

Purchasing power parity theory of the exchange rate is one of those empirical regularities that are sufficiently true over long periods of time to deserve our attention but deviations from which are pronounced enough to make all the difference in the short run. Clearly, purchasing power parity (PPP for short) is much like the quantity theory of money and indeed can be viewed as the open economy extension of quantity theory thinking.¹

i. PPP Theory

PPP theory argues that exchange rates move over time so as to offset divergent movements in national price levels. A country that experiences a hyperinflation, for example, will experience at the same time a corresponding external depreciation of its currency.

The theory leaves open two important operational questions. The first deals with the channels through which this relation between inflation

¹For extensive reviews see Officer (1976), Frenkel and Johnson (1978) and the collection of essays in the May 1978 issue of the Journal of International Economics.

differentials and depreciation will come about. The second question concerns the extent to which PPP is complete, -- does it hold in the short run and is there no possibility for trend deviations over time?

The extent to which PPP holds exactly, at every point in time, and without trend deviation has been an important issue in trade theory. There is no question that in theory the possibility of systematic deviation has been established that arise from the existence of nontraded goods. Specifically Balassa and Samuelson have argued that because services tend to be nontraded, labour intensive and show low technical progress as opposed to traded manufactures we would expect fast-growing and innovating countries to experience an increase in their real price level over time. With prices of tradeables equalized, the productivity growth in the traded sector would raise wages and the relative price of nontraded goods and thus the real price level in the fast growing countries.

A second source of systematic deviation has been pointed to by the earlier literature, including Viner, that dealt with the effect of capital flows or current account imbalance. Here it was argued that a borrowing country has a relatively high (real) price level. The argument here relies on the fact that an increase in aggregate demand, financed by borrowing and a current account deficit, would raise the relative price of nontraded goods and thus the real price level. There are thus two reasons for trend deviations or systematic deviations from PPP that serve as important reservations to the generality of the theory.

Setting these reservations aside we are still left with the issue of how rapidly and completely we expect PPP to hold and through what channels it comes about. Here the literature is considerably more diffuse. A hard core theory, associated with what Marina Whitman (1975) has aptly called "global monetarism" asserts the "law of one price". Goods

produced by us and by our competitors behave as if they were perfect substitutes. Simple arbitrage by market participants will establish uniformity of price in closely integrated markets.

This hard core view is no longer very fashionable except, of course, for raw materials, commodities and food. A more differentiated view would argue that in the short run and perhaps even in the long run there is substantial scope for product differentiation. Under these conditions price adjustment is no longer a matter of arbitrage but rather becomes a question of substitution. When our prices get out of line with those of our competitors so that we become more competitive, then we would expect demand to shift toward our goods, and in a fully employed economy, start putting upward pressure on costs and ultimately prices. The price adjustment here is certainly time consuming; it depends not only on substitutability between supply sources--Okun's distinction between customer and auction markets is important here--but also on the state of slack in the economy and on the expected persistence of real price changes. The description of this mechanism suggests that deviations from PPP are not only possible, but may persist for some time.

The empirical content of PPP theory can be summarized as in equation (1):

$$(1) \quad k = (1-a_1)\bar{k} + a_1 k_{-1} + a_2 z. \quad ; \quad 0 < a_1 < 1, \quad a_2 > 0$$

where k and k_{-1} measure the current and lagged deviation from PPP, $\bar{k}$ is the equilibrium real price level that has perhaps a time trend and z measures the systematic effect of borrowing or current account imbalance on the deviation from PPP. We would expect a_1 to be positive thus showing some serial correlation or persistence in deviations from PPP.

ii. Money, Prices and the Exchange Rate:

We turn now to a development of the 'monetary approach' of exchange rate theory. This model or approach combines the quantity theory of

money--fully flexible prices determined by real money demand and nominal money supply--with strict PPP to arrive at a theory of the exchange rate.

The approach can be simply formulated in terms of a combined theory of monetary equilibrium and exchange rate determination. Let M, P, V and Y be the nominal quantity of money, the price level, velocity and real income. Then the condition of monetary equilibrium can be written as:

$$(2) \quad \frac{M}{P} V(r, Y) = Y$$

where our notation indicates that velocity may be a function of other variables, such as interest rates, r , or income.

We can rewrite equation (2), solving for the price level, as:

$$(2)' \quad P = V \frac{M}{Y}$$

which states that for a given velocity an increase in money leads to an equiproportionate rise in the price level. A rise in velocity likewise raises the price level while an increase in real income, by raising real money demand, would lower the equilibrium level of prices.

To go from here to a theory of the exchange rate we draw on a strict version of PPP which states that our price level is equal to foreign prices, P^* , converted at the exchange rate, E :

$$(3) \quad P = P^* E$$

where E is the domestic currency price of foreign exchange. Substituting (3) in (2)' yields an expression for the equilibrium exchange rate:

$$(4) \quad E = (1/P^*) V \frac{M}{Y}$$

The equilibrium exchange rate depends on nominal money, real output and velocity. An increase in nominal money or in velocity will depreciate the exchange rate in the same proportion. A rise in real income will lead to appreciation. What is the mechanism?

The theory argues that domestic prices are fully flexible, but are linked to world prices by PPP. Given the nominal quantity of money any variations in the demand for money must be offset by compensating changes in the level of prices and thus in the exchange rate. An increase in real money demand, because say of an increase in real income, will be accommodated by a decline in the level of prices so as to raise the real value of the existing nominal money stock. With a decline in our prices, though, we are out of line with world prices and thus require appreciation of the exchange rate.

To complete the theory we note two extensions. First there is symmetry in that the foreign price level, P^* , is determined by foreign money demand and supply so that we can write (3) as

$$(4)' \quad E = \left(\frac{M}{M^*}\right) \left(\frac{V}{V^*}\right) \left(\frac{Y^*}{Y}\right)$$

Clearly then, what matters for exchange rate determination in this view is relative money supplies, velocities and real incomes in the two countries. Our exchange rate will depreciate if, other things equal, our nominal money stock rises relative to that abroad.

The second extension is a specification of a velocity function. Here the tradition has been to assume that velocity depends on real income and the alternative cost of holding money:

$$(5) \quad V = Y^{\lambda-1} \exp(\theta r)$$

where r is the nominal rate of interest. The functional form is a matter of expositional convenience and monetary tradition.

Substituting (5) in (4)' and taking logs we obtain the standard equation of the "monetary approach":¹

$$(6) \quad e = m - m^* - \lambda(y - y^*) + \theta(r - r^*)$$

¹ The literature of the monetary approach has predominantly used the forward premium rather than the interest differential. See for example Frenkel and Clements (1978). The theoretical rationale is, I believe, the idea that the relevant substitution is between domestic and foreign monies rather than between money and bonds. For a further discussion see Abel et al. (1977).

where e, m, m^*, y, y^* are logarithms of the corresponding capital letter variables.

In the final form, equation (6) shows that an increase in our relative money stock or a decline in our relative income will lead to depreciation as would a rise in our relative interest rate. The last conclusion is particularly interesting since it certainly is the opposite of the conventional wisdom that a rise in interest rates will lead to appreciation. We return to the question below when we compare the relation between interest rates and the exchange rate in alternative theories. We note here the explanation: an increase in interest rates reduces the demand for real money balances. Given the nominal quantity of money the price level has to rise to reduce the real money stock to its lower equilibrium level. With our prices thus getting out of line internationally a depreciation is required to restore PPP.

2. Balance of Payments Theory of Exchange Rates

A textbook view of exchange rates will argue that the exchange rate adjusts to balance receipts and payments arising from international trade in goods, services and assets. The current account is affected by the exchange rate because it changes relative prices and thus competitiveness, the capital account is affected to the extent that expectational considerations are important. The theory can be formulated with the help of equation (7):

$$(7) \quad \text{BoP} = 0 = C(EP^*/P, Y, Y^*) + K(r, r^*, s)$$

where BoP denotes the balance of payments, EP^*/P measures the relative price of foreign goods and thus serves as a measure of our competitiveness, C denotes the current account, K the rate of capital inflow and s is a speculative variable which we disregard for the present.

Figure 1 shows the schedule BB along which our balance of payments is in equilibrium, given prices, foreign income, and interest rates. A rise

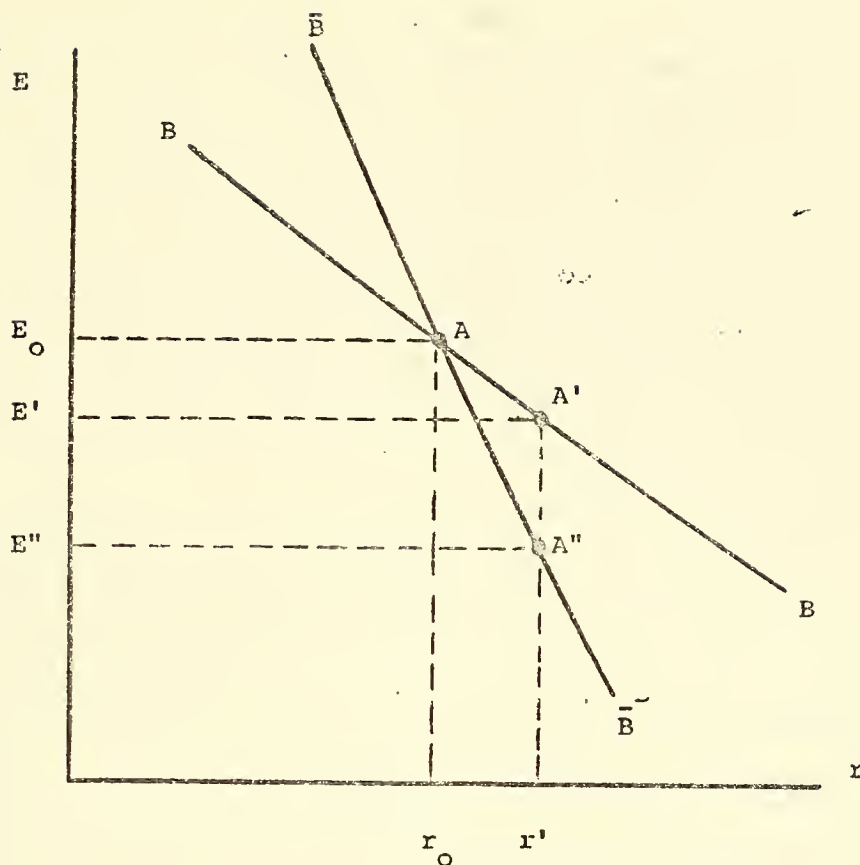


FIGURE 1

in E or a depreciation of the exchange makes us more competitive and thus improves the current account. To restore overall balance of payments equilibrium lower interest rates are required so as to generate an offsetting rate of capital outflow. We can readily show that in this framework the exchange rate depends on interest rates, activity levels, relative price levels and the exogenous determinants of the composition of world demand:

$$(8) \quad E = E(Y, Y^*, r, r^*, P^*/P)$$

Specifically, an increase in our income, because of say an autonomous increase in spending, will worsen the current account and thus requires an offsetting depreciation. An increase in foreign prices leads to a

precisely offsetting appreciation and an increase in our interest rate leads to an appreciation. The mechanism through which higher interest rates at home lead to an appreciation can be illustrated with the help of Figure 1. In the first place the increase in interest rates will lead to a net capital inflow or a reduced rate of outflow and thus causes the overall balance of payments to move into surplus. The exchange rate will accordingly appreciate--assuming the right elasticities--until we have an offsetting worsening of the current account. This is shown by the move from A to A' on BB.

We may not want to stop at this point but rather recognize that the higher interest rates and the exchange appreciation will exert subsidiary domestic effects. With higher interest rates aggregate demand declines and thus output will fall. The same effect arises from the appreciation and the resulting deterioration of the current account. Thus we have a second round of adjustments to the decline in income which shifts the BB schedule inward over time. The longrun balance of payments schedule that incorporates the equilibrium level of income implied by the real exchange rate and interest rate is the steeper schedule $\overline{BB}$. In the longrun we have further appreciation until point A" is reached.

Two points deserve emphasis here. First, the approach views changes in exchange rates as changing (almost one for one) relative prices and competitiveness. It in this respect represents a view opposite to that embodied in the monetary model. Second, it contradicts the monetary model in predicting that an increase in interest rates will lead to an appreciation. I will not pursue this model further, but rather take a specialized version and embody it in a macroeconomic setting.

3. The Mundell-Fleming Model:

The balance of payments model has drawn attention to the role of

capital flows in the determination of exchange rates. This is also the perspective adopted by the modern macroeconomic approach to exchange rate determination that originated with the pathbreaking work of Mundell (1968) and Fleming (1962). Their theory argues that the exchange rate enters the macroeconomic framework of interest and output determination because changes in exchange rates affect competitiveness. Depreciation acts much in the same way as fiscal policy by affecting the level of demand for domestic goods associated with each level of output and interest rate. A depreciation shifts world demand toward our goods and thus acts in an expansionary manner.

The Mundell-Fleming model is illustrated in Figure 2 for the case of perfect capital mobility. Perfect capital mobility means that there is only one rate of interest at which the balance of payments can be in equilibrium. If the rate were lower there would be outflows that would swamp any current account surplus and conversely if it was higher. This is illustrated by the horizontal BB schedule. The LM schedule is the conventional representation of monetary equilibrium. Higher income levels raise the demand for money. Given the money stock, interest rates will have to rise to contain money demand to the existing level of supply. Finally the IS schedule resembles that of a closed economy except that it includes as a component of demand net exports as determined by income and competitiveness. That is why a depreciation will shift the IS schedule out and to the right.

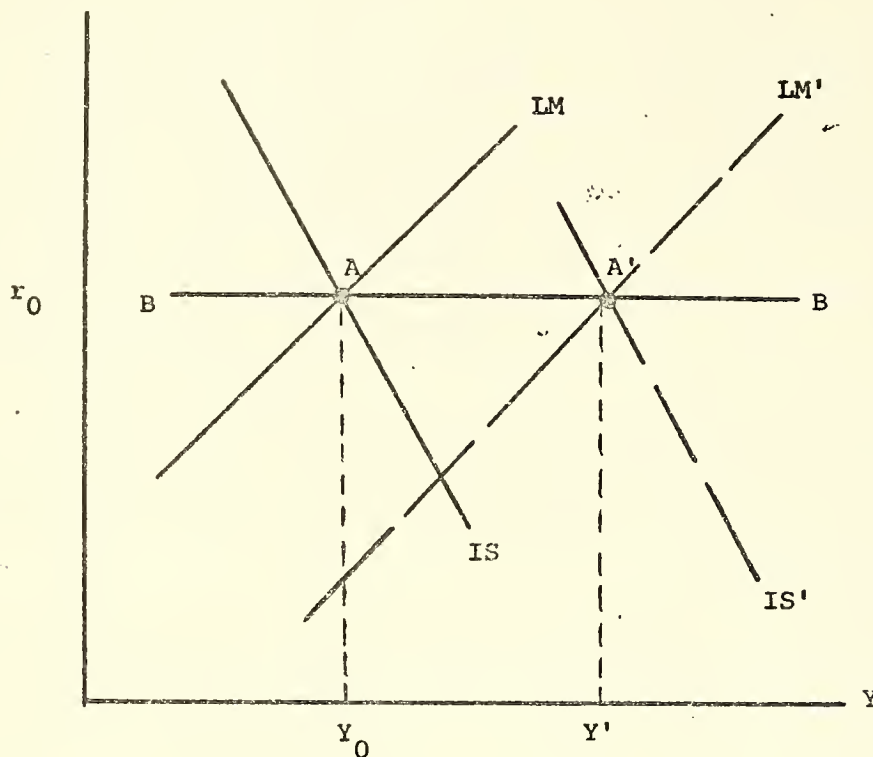


FIGURE 2

Consider now a monetary expansion indicated by a rightward shift of the LM schedule. The impact effect is of course to lower interest rates and thus to exert an expansionary effect on demand. The decline in interest rates, however, leads to exchange depreciation because of incipient capital outflows. The depreciation in turn enhances our competitiveness raising demand and shifting the IS curve to the right

until we reach point A' . Here output and income have risen sufficiently for the increased money stock to be held at the initial rate of interest.

The framework has an important lesson for exchange rate theory and monetary policy. First, under conditions of perfect capital mobility and

given the world rate of interest, monetary policy works not by raising the interest sensitive components of spending, but rather by generating a depreciation and thereby a current account surplus. Monetary policy works not through the construction sector but rather through the net export component of demand. This is of course a striking result, due in part to the small country assumption. It draws attention to the central role of net exports in aggregate demand and to the link between interest rates and exchange rates. It is the latter link that has become central to recent exchange rate models.

The theory implies an equilibrium exchange rate which we can obtain either from the condition of goods market equilibrium:¹

$$(9) \quad E = E(r, Y, Y^*, P^*/P, \dots)$$

or as a reduced form equation of the full system:

$$(10) \quad E = E(M, Y^*, \dots)$$

where the dots denote fiscal policy variables and other exogeneous determinants of goods and money demand. It is interesting to note that in (9) an increase in the (world) interest rate, because it reduces aggregate demand and thus creates an excess supply of goods, requires an offsetting depreciation that increases competitiveness and gives rise to a trade surplus.

In its present form the model has three limitations: First, there is no role whatsoever for exchange rate expectations. This point is important because it implies that strict interest equality must obtain internationally. Second, the model allows for no effect from the depreciation on domestic prices. The depreciation is not allowed to affect either the general price

¹ The condition of goods market equilibrium is: $Y = A(r, Y) + C(EP^*/P, Y, Y^*)$ where $A()$ denotes aggregate spending by domestic residents and C is the trade balance. We solve the equation for the exchange rate to obtain (9).

level, and therefore the real value of the money stock, or the price of our output and therefore our competitiveness. It is quite apparent that in fact we should expect at least some spillover into domestic prices and that the extent to which the real effects of a monetary expansion are dampened. We return to this question in section 5 below and in part II where we look at the empirical evidence. The third limitation concerns the absence of any dynamics. This limitation is important not only in respect to the price adjustment that we just noted but also for the adjustment of trade flows. The existence of adjustment lags, reviewed below in part II, implies the possibility that monetary policy in the shortrun may fail to be expansionary.

4. The Portfolio Balance Model:

The Mundell-Fleming model emphasizes the high substitutability between domestic and foreign assets. Capital mobility is perfect so that the slightest deviation of interest rates from the world level unleashes unbounded incipient capital flows. An alternative formulation emphasizes a more limited substitutability between domestic and foreign assets and introduces the level of the exchange rate as a variable that along with asset yields helps achieve balance between asset demands and asset supplies.¹ The model concentrates on asset markets but can readily be extended to include the allocational effects of exchange rates in affecting the current account.

Consider now the basic model as shown in equations (11)-(13) and Figure 3. In equation (11) we show the condition of monetary equilibrium where W denotes nominal wealth and where $\phi(r, r^*)$ is the fraction of wealth people wish to hold in the form of domestic money:

$$(11) \quad M = \phi(r, r^*)W \quad \phi_r, \phi_{r^*} < 0$$

Equilibrium in the market for domestic assets requires that the existing supply, X , equal the demand:

$$(12) \quad X = \psi(r, r^*)W \quad \psi_r > 0; \quad \psi_{r^*} < 0$$

where $\psi(r, r^*)$ is the desired ratio of domestic assets to wealth. The ratio is assumed to increase with the own rate of return and to decline with the return on foreign assets. Equations (11) and (12) together with the wealth constraint:

$$W = M + EF + X$$

imply an equilibrium condition in the market for net external assets:

$$(13) \quad EF = (1 - \psi - \phi)W = \rho(r, r^*)W \quad ; \quad \rho_{r^*} > 0, \quad \rho_r < 0$$

where F denotes net holdings of foreign assets measured in terms of foreign exchange. Note that since net external assets can be negative, ρ can be negative. We assume that assets are substitutes so that asset demands respond positively to their own yield and negatively to yields on alternative assets,

¹ Portfolio balance models as discussed here have been developed among others by Boyer (1977), Dornbusch (1975), Dornbusch and Fischer (1978), Flood (1976), Henderson and Gorton (1975), Kouri (1976, 1977), Branson (1976), and Porter (1977).

In figure 3 we show the money and domestic asset market equilibrium schedules for given stocks of each of the assets. Along MM the domestic money market is in equilibrium. Higher interest rates reduce money demand so that equilibrium requires a depreciation and thus a rise in the domestic currency value of foreign assets and hence wealth. The exchange rate thus plays a balancing role by affecting the valuation of assets. Along XX the domestic asset market is in equilibrium. Higher interest rates raise the demand for domestic assets and thus require an appreciation to reduce wealth and asset demand thus restoring equilibrium.

We want to establish next the effect of changes in foreign interest rates, changes in domestic money or net external assets. In terms of Figure 3 an increase in the foreign interest rate creates an excess supply of domestic money and domestic securities thus shifting the MM schedule down and to the right and the XX schedule up and to the right. Without question the equilibrium exchange rate depreciates.

Consider next an increase in the domestic money stock. At the initial equilibrium there will be an excess supply of money and an excess demand for domestic (and foreign) securities. Accordingly the MM schedule will shift down and to the right while the XX schedule shifts down and to the left. It is readily established that the net effect is unambiguously a depreciation of the exchange rate.¹

Finally we consider an increase in net external assets. Now both the money market and the domestic security market schedules shift to the left.

¹ Using equations (11) and (12) along with the definition of wealth we have:

$$dE/dM = \left(\frac{1}{F} \right) \frac{\Psi_r (1-\phi) + \Psi \phi_r}{\phi \Psi_r - \Psi \phi_r} = \frac{1}{F} \frac{\Psi_r \rho + \Psi (\Psi_r + \phi_r)}{\phi \Psi_r - \Psi \phi_r} > 0$$

which is positive on our assumption of substitution.

They will shift in the same proportion, as inspection of (11) and (12) together with the wealth constraint will reveal. Accordingly the equilibrium exchange rate appreciates in proportion to the increase in foreign assets.

The implications of the portfolio balance model are summarized in equation (14) which shows the reduced form equation for the equilibrium exchange rate:¹

$$(14) \quad E = E(r^*, M, X, F); \quad E_{r^*} > 0; \quad E_M > 0; \quad E_X > 0; \quad E_F < 0.$$

Furthermore since (14) is homogeneous in domestic nominal money and securities we can rewrite the equation as:²

$$(14)' \quad E = \gamma(r^*, X/M) \frac{M}{F}$$

In this form we emphasize that the equilibrium exchange rate depends on relative asset supplies. In particular an increase in domestic nominal assets--money and securities--relative to external assets will lead to an equiproportionate depreciation. This homogeneity property is, of course, desirable since it corresponds to an ongoing, neutral inflation process.

The portfolio balance model draws attention to the substitution possibility between domestic and foreign assets. Domestic and foreign securities are no longer perfect substitutes and accordingly their relative supplies determine, along with the nominal money stock, equilibrium interest rates and the exchange rate. A link with the current account is established

¹ The effect of an increase in domestic securities on the equilibrium exchange rate is ambiguous.

² To derive (14)' we note that taking the ratio of (11) and (12) and solving for the equilibrium interest rate we have: $r = h(r^*, X/M)$.

From (13) and the wealth definition we obtain: $E = \frac{\rho}{1 - \rho} (M/F + X/F) = (M/F) \frac{\rho}{1 - \rho} (1 + X/M)$. Substituting the equilibrium interest rate

$r = h(r^*, X/M)$ yields (14)', where $\gamma(r^*, X/M) \equiv \frac{\rho(r^*, h(r^*, X/M))}{1 - \rho(r^*, h(r^*, X/M))} (1 + X/M)$.

by virtue of the fact that external assets are acquired over time through the current account surplus. Accordingly, as Kouri (1976, 1977) and others have emphasized, the current account determines the evolution of the exchange rate over time. In particular a current account surplus which implies accumulation of net external assets leads to an appreciating exchange rate.

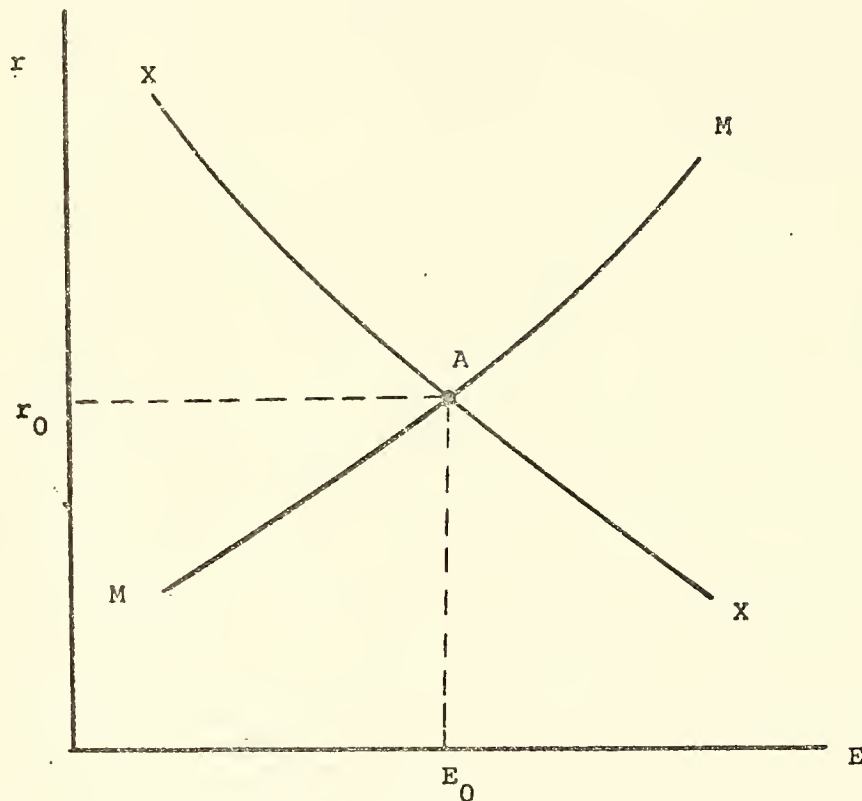


FIGURE 3

The model remains a partial equilibrium representation in two important respects. First, we do not consider the interaction between financial markets, the exchange rate, goods markets, and the current account. Second, we do not allow for any expectational effects.

What makes this model potentially attractive for the analysis of exchange rate questions is the direct relation between asset market disturbances and movements in exchange rates. It extends the monetary model because we do not have to rely on shifts in money demand or supply as sole determinants of exchange rate movements but rather can consider shifts between domestic and foreign assets, for example, as motivated by say expectations.

5. Expectations and Exchange Rate Dynamics

We have so far concentrated on models of the exchange rate that are largely static and that do not emphasize the role of expectations. We extend the analysis now to questions of dynamics and to the place of expectations. The role of expectations is central to exchange rate determination, and therefore to policies under flexible exchange rates. The spot exchange rate is almost entirely dominated by the course the public expects it to take in the near future. These expectations, of course, are influenced by the structure of the economy and institutional features such as indexing or systematic policy responses. We will in this section first review a fairly general model of exchange rate expectations and dynamics and then extend the analysis to discuss the idea of a virtuous and vicious circle.¹

i. Expectations:

We return to the assumption of perfect capital mobility to establish

¹ This section draws on Dornbusch (1976).

a relationship between interest rates, current exchange rates and expected exchange rates. With perfect capital mobility asset holders would find themselves indifferent between holding domestic or foreign assets provided they carry the same yield, that is provided the interest differential matches the anticipated rate of depreciation:

$$(15) \quad r-r^* \approx (\bar{E}/E - 1)$$

where $r-r^*$ is the interest differential, and where $(\bar{E}/E - 1)$ is the expected depreciation of the domestic currency which is defined as the percentage excess of the expected future spot rate, $\bar{E}$, over the current spot rate, E . We can rewrite (15) to yield an equation for the spot rate:

$$(15)' \quad E = \frac{\bar{E}}{1 + r-r^*}$$

Equation (15)' is central to a correct interpretation of exchange rate movements. It argues that movements in the spot rate are due either to changes in interest differentials, given expectations or to changes in expectations over the future course of exchange rates. Specifically, an increase in our interest rate will lead to an appreciation. The anticipation of depreciation, given interest rates, will lead to an immediate depreciation in the same proportion.

We close the model of exchange rate determination with a theory of nominal interest rates and a theory of how exchange rate expectations are formed. This is the point where our model ties in with the earlier theories. Thus we can appeal, for example, to the Keynesian model to argue that interest rates are determined by income, the terms of trade and the real money stock. Suppose the foreign interest rate is given. The domestic interest rate, using the condition of money market equilibrium as

implicit in an LM schedule, will depend on income and real money:

$$(16) \quad r = r(M/P, Y)$$

The expected future or longrun equilibrium exchange rate, $\bar{E}$ can be written as a function of the terms of trade, σ , and longrun price levels, $\bar{P}/\bar{P}^*$

$$(17) \quad \bar{E} = \sigma \left(\frac{\bar{P}}{\bar{P}^*} \right) = \sigma \left(\frac{\pi \bar{M}}{\pi^* \bar{M}^*} \right)$$

which in turn are proportional to longrun money stocks $\bar{M}$, $\bar{M}^*$ with the factors of proportionality, π and π^* , determined by exogeneous real variables. Substituting (16) and (17) in (15)' gives us a reduced form equation for the equilibrium exchange rate:

$$(18) \quad E = \frac{\sigma \left(\frac{\pi \bar{M}}{\pi^* \bar{M}^*} \right)}{1 + r(M/P, Y) - r^*} = E(\sigma, M/P, Y; \pi, \pi^*, \bar{M}, \bar{M}^*)$$

What are the implications of our model for exchange rate determination and monetary policy. The analysis is helped by Figure 4. The schedule QQ shows the equilibrium exchange rate of (18) for given longrun money, terms of trade and price levels and a given foreign interest rate.

The QQ schedule is downward sloping since, given money, a higher price level, say a move to point A''- raises the equilibrium interest rate at home and thus creates a differential in favor of the home country. To offset the differential the spot rate must appreciate-- E must decline--to the point where the anticipated rate of depreciation matches the interest differential.

How will a permanent increase in the money stock work itself out in this framework? An increase in money in the longrun, with all prices flexible will increase prices and exchange rates in the same proportion. This implies that the QQ schedule shifts out to Q'Q' and that in the final longrun equilibrium we will be at point A' with all real variables unchanged. In the shortrun, though, an increase in nominal money is an increase in the real money stock. Prices are unlikely to jump and therefore a

lower rate of interest is required for the public to hold the higher real money stock. With a decline in interest rates there will be an incipient capital outflow until the exchange rate has depreciated enough to create the anticipation of appreciation exactly at the rate of the interest differential. This is true at point A" where the exchange rate has depreciated beyond its new longrun level. This overshooting of exchange rates is an essential counterpart of permanent monetary changes under conditions of shortrun price stickiness and perfect capital mobility.

By how much will exchange rates overshoot? That depends on the nature of the price adjustment process. If prices rise very rapidly because interest response of money demand is low and that of goods demand is high or because demand is highly responsive to relative prices--then the overshooting will tend to be small. Conversely, if the adjustment process of prices is slow then the overshooting is large.

The adjustment, following the impact effect of an increase in money, is shown in Figure 4 by the movement along Q'Q'. The exchange rate has depreciated thus making domestic goods more competitive. Interest rates at home have declined thereby raising demand. Both factors work to put upward pressure on our price level. Prices will rise, real money declines and interest rates rise back up until the new longrun equilibrium at A' is reached.

ii. Virtuous and Vicious Cycles¹

The framework we have laid out here helps understand a controversy that has developed about the working of a flexible rate system. It has been argued that flexible rates make inflation stabilization more difficult in soft currency countries and more easy in hard currency countries.

1

The virtuous and vicious cycle has been discussed among others by Krugman (1977), Sachs (1978), Basevi and de Grauwe (1977) and Willett (1977).

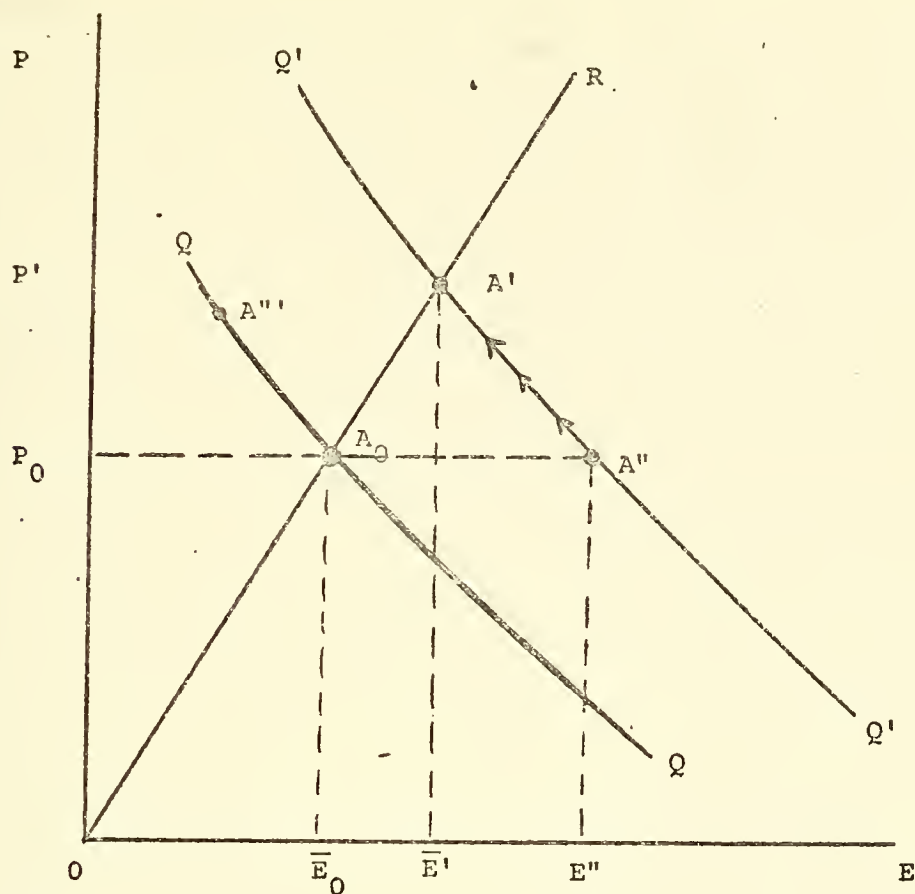


FIGURE 4

The reason is that monetary policy, through the rapid reaction of exchange rates and through the overshooting, exerts rapid inflationary pressure in expanding countries and inflation-dampening in relatively tight countries. Monetary policy becomes quite possibly ineffective if one recognizes that the inflationary pressure of depreciation is quite soon translated into domestic price increases. These price increases limit the gain in competitiveness from a depreciation.

In these circumstances monetary policy is primarily inflationary, it has very little if any effect on real aggregate demand. All that would happen is that renewed attempts at stimulating aggregate demand would translate into increasing inflation rather than more employment.

What institutional factors would check or enhance such an ostensibly unstable process? It has been argued with force that the virtuous and vicious cycle is entirely a matter of monetary determination. Unless monetary policy validates the depreciation it will ultimately undo itself. There can be little disagreement with this conclusion, except that it is fundamentally irrelevant as an observation about policy. The relevant policy setting is one where wide-spread indexation, for example, will immediately translate depreciation into wage and price inflation with the consequence of growing unemployment if the central bank fails to accommodate through further monetary expansion. The central bank may in practice have very little power to stop this inflationary process and the right starting point is incomes policy not monetary policy. At the same time it is, of course, true that the prospect of an effective stabilization program will immediately receive the side benefit of an appreciation and a consequent bonus in terms of inflation reduction.

6. Summary:

We have now reviewed a wide spectrum of exchange rate theories. There is little purpose in endorsing one particular formulation since each of these models seeks to capture a special effect and thus is more or less suitable for a particular instance of policy analysis. Some models view the place of the exchange rate mainly in its shortterm effects on competitiveness and its longterm role in keeping in line prices internationally. Monetary and portfolio models assign importance to exchange rate movements through valuation effects, exchange rate movements change the real value of the money stock or the relative supplies of domestic and foreign assets.

If a choice has to be made between models then I do see a difference between Quantity Theory oriented models that leave for the exchange rate the

purely passive role of keeping the current stock of real balances just right and expectations oriented asset market models in which the current level of the exchange rate is set primarily by reference to its anticipated path. In this latter perspective changes in current rates bring about an adjustment dynamics the details of which depend on the differential speeds of adjustment in goods and money markets and where the adjustments that are taking place are quite possibly directed toward events that have not yet materialized but are already anticipated.

Monetarist models, of course, also recognize the importance of expectations. In those models, however, the spot rate is influenced by the effect of anticipated depreciation on real money demand. The anticipation of depreciation would reduce real money demand thus raising the price level and therefore, via PPP, lead to a depreciation of the exchange rate. The extent of the depreciation depends on the interest responsiveness of money demand. By contrast in the present model the anticipation of depreciation leads directly, as of given prices and interest rates, to an equiproportionate depreciation of the spot rate.

From the perspective of monetary policy these two strands of modelling differ of course quite radically. The Quantity Theory model assumes quite literally that prices are fully, instantaneously flexible. It thus cannot have any use for monetary policy, except perhaps to stabilize the price level in the face of money demand fluctuations. All other models, of course share a macroeconomic--as opposed to monetarist--persuasion where monetary policy works, more or less, because the central bank can move the real money stock. In this perspective exchange rates become a vehicle for monetary policy. One of the chief channels of monetary policy is the direct effect of money on interest rates and on the exchange rate and thereby on

relative prices and aggregate demand. The empirical problem is of course whether this link makes price adjustment more rapid, or to put it differently, whether flexible rates make the Phillips curve steeper.

II. SOME EMPIRICAL EVIDENCE

In this part we will look at some of the empirical evidence that has a bearing on the exchange rate models discussed above. We will start with the evidence on PPP. From there we turn to the monetary model of exchange rates which is reviewed in section 2. The asset market model is considered in section 3. A discussion of the two key issues for monetary policy--the inflationary impact of import price changes and the response of trade flows to relative prices--is presented in section 4..

1. The Evidence on PPP

PPP has been studied in the literature for the last fifty years. We draw attention here to the recent review by Officer (1976) and a careful study by Kravis and Lipsey (1978). Most students of PPP conclude that the theory does not hold up to the facts except in a very loose and approximate fashion. Thus Table 1 shows inflation and depreciation rates for some industrialized countries. It is true that the high inflation countries experienced on average a depreciation in their effective exchange rates. It is also true, however, that the matching between inflation differentials and depreciation is not very close.

To gain some measure of the performance of PPP we have looked at the real exchange rate for the US and Germany. The real exchange rate here is defined as the ratio of the US CPI multiplied by the exchange rate (DM/\$) and divided by the German CPI, EP^*/P . On strict PPP grounds that ratio should be independent of the exchange rate and should not show any persistence in deviations from its mean. Chart 1 shows the log of the real exchange rate as the solid line. Needless to say the real exchange rate shows very substantial fluctuations that are systematically associated with movements in the exchange rate. Thus in mid 1975 for example

Table 1: INFLATION AND DEPRECIATION: 1970-77

(Average Annual % Rates)

	CPI	Deflator	Effective Nominal Rate	Effective Real Rate	\$ Rate
Canada	7.5	8.4	-.3	.5	-.0
France	9.0	9.0	-.2	.8	-1.7
Germany	5.6	5.7	- 5.3	-2.1	-6.3
Italy	12.9	n.a.	7.4	1.7	5.1
Japan	10.7	8.7	- 3.6	-1.3	-4.1
UK	13.9	14.3	6.4	.9	4.7
US	6.6	6.4	2.0	2.2	--

Note: In the last three columns a minus sign indicates an appreciation of the effective rate and an appreciation relative to the \$ US respectively. The effective real rate is based on wholesale prices.

Source: International Financial Statistics

the dollar appreciated relative to the DM by nearly ten percent and we see in the chart associated increase in the real exchange rate. Conversely, the depreciation of the dollar in late 1977 and early 1978 is reflected in a declining real exchange rate.

Can these deviations from PPP be modelled in a simple fashion? In particular are these deviations from PPP shortlived and self-liquidating? A formulation that tests this hypothesis regresses the log of the real exchange rate, $k = e + p^* - p$, on its own lagged value and a constant: Using monthly data for the period March 1974-May 1978 we obtain:

$$(19) \quad k = .33 + .69k_{-1} \quad \text{Rho} = .65 \quad \text{SER} = .018 \quad \text{DW} = 1.91$$

(.11) (.10)

The model suggests that deviations from PPP do have persistence.

$$\text{Log} \left(\frac{\text{DM}/\$ \cdot P^{\text{US}}}{P^{\text{GER}}} \right)$$

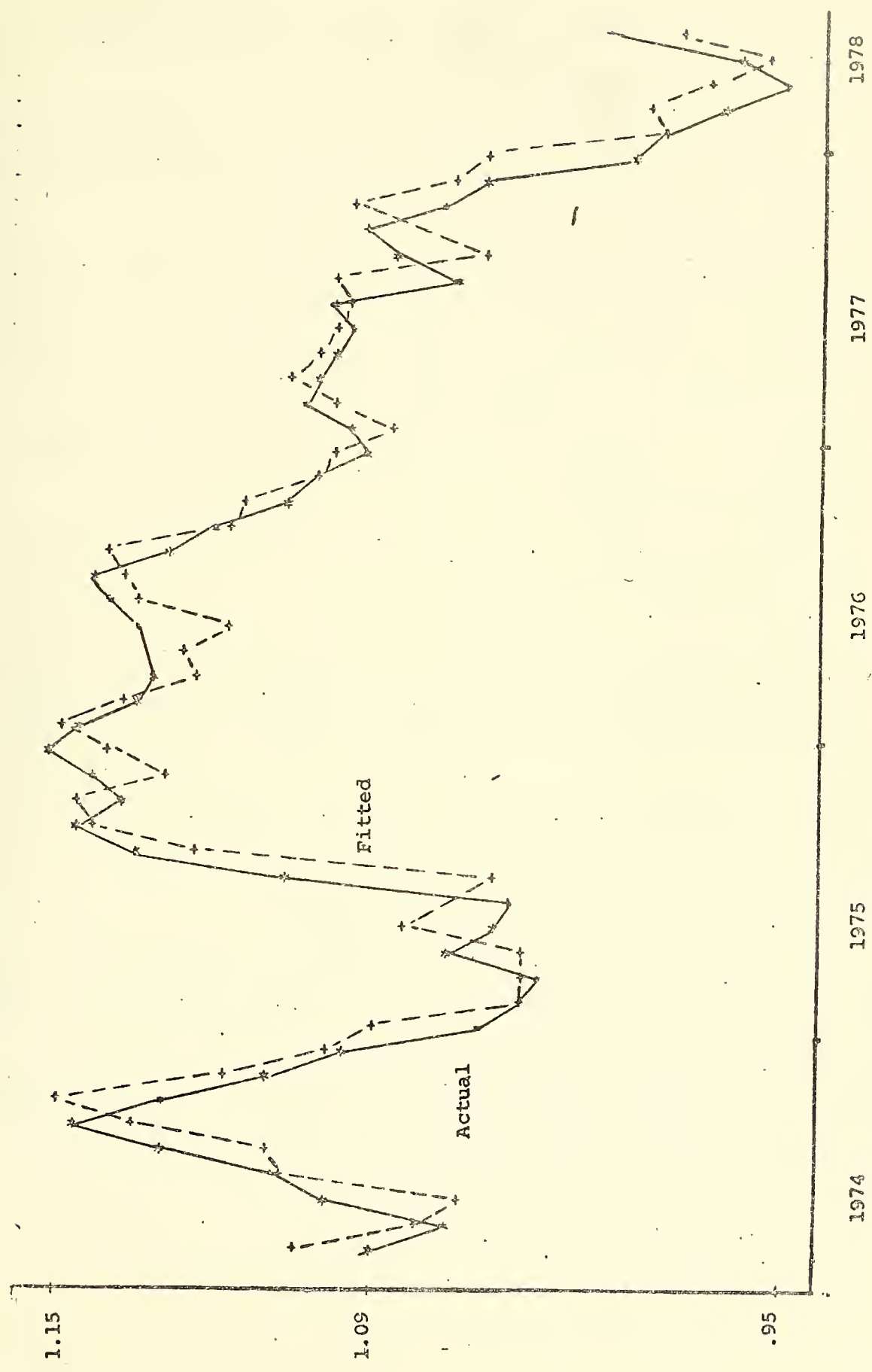


CHART 1 THE GERMAN-US REAL EXCHANGE RATE

To make that point we can rewrite (19) in terms of its longrun value E:

$$(19)' \quad k = .31\bar{k} + .69k_{-1}$$

so that the real exchange rate depends to the extent of one third on its longrun value and two-thirds on its recent history.¹

One strand of literature, referred to earlier, views deviations from PPP that are associated with current account imbalance and capital flows. To the extent that an increase in interest rates will draw in capital flows we would expect the interest differential to help explain deviations from PPP. In (20) we report a PPP equation that includes the interest differential as an explanatory variable:

$$(20) \quad k = .19 + .81k_{-1} - 2.61(r-r^*) \quad \text{Rho}=.60 \quad \text{SER}=.018 \quad \text{DW}=1.90$$

$$(.12) \quad (.10) \quad (1.56)$$

The equation shows that an increase in the interest differential in favor of Germany would cause the real exchange rate to decline. That would correspond to the case where the interest differential appreciates the mark at unchanged prices. While the interest differential thus has the expected sign it is very imprecisely estimated and contributes little to explaining the behavior of the real exchange rate.

We have now seen the evidence on substantial and persistent deviations from PPP. I believe there is no surprise, if only because of the important role of nontraded goods. Consider for example the rates of inflation for different price indices reported in Table 2. We limit ourselves to Japan and Germany since these are the only countries that report export and

¹ From (19) we have $\bar{k} = \frac{.33}{1 - .69} = \frac{.33}{.31}$. We can therefore rewrite (19)

$$\text{as } k = .31 \left(\frac{.33}{.31} \right) + .69k_{-1} \quad \text{or } k = .31\bar{k} + .69k_{-1}.$$

import prices (as opposed to unit values). The table reveals persuasively the very substantial changes in relative prices. Export prices systematically rise at lower rates than the GNP deflator thus lending impressive support to the Balassa-Samuelson hypothesis. The terms of trade--the ratio of export to import prices--change by more than half a percent per year.

Table 2: MEASURES OF PRICE CHANGE

(Average Annual % Rates)

	CPI	GERMANY		IMP		JAPAN		IMP
		DEF	EXP			DEF	EXP	
1958-70	2.4	4.0	1.2	-0.3	5.2	4.9	0.8	0.2
1958-77	3.5	4.6	2.6	2.1	7.2	6.3	3.8	4.1

Source: Federal Reserve Bank of St. Louis and International Financial Statistics

In addition to sectoral changes in relative prices over time we have to recognize that pricing strategies differ across industries, across countries and across the business cycle. In the US pricing in manufacturing has been based on standard unit labor costs with little impact of aggregate demand or competitors' prices. Abroad there is evidence for substantially more flexible prices. The asymmetry reduces but does not eliminate the scope for exchange rate changes to affect relative prices and thus bring about deviations from PPP.

2. The Monetary Approach

The sharpest formulation of exchange rate determination is the "monetary approach" that is associated with the University of Chicago. It is represented in work such as Bilson (1978a, b, c) Dornbusch (1976b), Frenkel (1976), Frenkel and Clements (1978) and Hodrick (1978). The approach assumes, as we have seen, perfect price flexibility as well as PPP.¹ With these assumptions monetary equilibrium here and abroad implies an equilibrium exchange rate that can be written as in (6) and is repeated here for convenience:

$$(6) \quad e = m - m^* - \lambda(y - y^*) + \theta(r - r^*)$$

The theory predicts that an increase in our income will appreciate the exchange rate and that monetary expansion or higher interest rates will depreciate the exchange rate. Equations such as (6) have been estimated for France in the 20's, Germany in the hyperinflation period, the UK and Germany and the US and Germany in the 70's. Table 3 reports in equations 1. and 4. estimates for such an equation. In each case the coefficient on relative money supplies was restricted to unity. The estimates for the period March 1974-May 1978 show that the coefficients have the expected sign, although the coefficient on interest rates is not statistically significant. We also note the very high estimate of serial correlation and the low level of the Durbin Watson even after correction for serial correlation. In sum, the equation is not very satisfactory.

¹ PPP is not always assumed to be instantaneous. Bilson (1978) allows for autoregressive adjustment such as in (19').

There are several improvements on the basic formulation that deserve attention. A first one recognizes that the demand for money is poorly specified. There is no recognition of adjustment lags, although they have been found significant in domestic studies of money demand.¹ Nor does the equation include a longterm interest rate or deposit rate that measures the alternative cost of holding money rather than longterm assets.

In equation 2. and 4. we show equations that include both a shortterm and a longterm interest differential. The coefficient of the longterm rate is of the expected positive sign and is statistically significant.

In equations 3. and 6. we complete the specification of money demand by allowing for partial adjustment so that our exchange rate equation becomes:

$$(6)' \quad e = m - m^* + a_0(e + m^* - m)_{-1} - a_1(y - y^*) + a_2(r - r^*) + a_3(r_L - r_L^*)$$

This specification shown in Chart 2 substantially improves the equation by reducing the standard error and raising the Durbin Watson. The lagged coefficient is of the expected sign and magnitude and is statistically significant. At the same time, however, the adjustment changes the sign of the shortterm interest differential which now becomes negative,

¹ In Bilson (1978b) the possibility of lagged adjustment of real money demand is explicitly recognized. In the empirical implementation, however, only a lagged exchange rate is used.

$\Delta m^* - m$

Fitted

Actual

— Actual

- - - Fitted

1974

1975

1976

1977

Chart 2: THE MODIFIED MONETARY APPROACH

although it remains insignificant. This change of sign is maintained when instrumental variables estimation is used as in 6. In fact the stability of the coefficients across estimation techniques lends further support to our formulation.

One interpretation of this sign pattern has been offered by Jeffrey Frankel (1978). He argues that the exchange rate equation of the form shown in 2. or 4. is a reduced form equation from a system where we have both shortterm real effects of monetary changes and longerterm inflation differentials. In this perspective a rise in the shortterm rate has to

MONTHLY DM/\$ EXCHANGE RATE EQUATIONS: 1974/3 - 1978/5

#	$m-m^*$	$(e+m^*-m)_{-1}$	$(y-y^*)$	$(r_s - r^*)$	$(r_L - r_L^*)$	const.	Rho	SER	DW
1.	1		-.41 (.20)	.87 (1.61)		1.13 (.10)	.97	.021	1.28
2.	1		-.38 (.20)	.14 (1.61)	9.12 (4.38)	1.24 (.09)	.97	.021	1.41
3.	1	.67 (.11)	-.23 (.17)	-1.05 (1.49)	10.27 (3.18)	.46 (.20)	.53	.018	1.94
4.	1		-.45 (.21)	3.23 (3.14)		1.13 (.12)	.97	.022	1.36
5.	1		-.61 (.33)	8.01 (6.65)	29.55 (3.52)	1.44 (.03)	.65	.029	1.79
6.	1	.57 (.21)	-.26 (.27)	-1.51 (5.56)	13.37 (6.33)	.60 (.31)	.58	.018	1.90

Notes: The estimated equation is: $e+m^*-m = \text{const} + a_0(e+m^*-m)_{-1} + a_1(y-y^*) + a_2(r_s - r_s^*) + a_3(r_L - r_L^*)$ where all variables are defined in the text. Equations 1-3 were estimated using a correction for first order serial correlation. Equations 4-6 were estimated using Fair's method with production, the lagged right and left hand variables and time as instruments. Standard errors in parentheses.

be matched by depreciation to generate an offsetting expectation of appreciation. Changes in the longterm interest differential, by contrast, are a proxy for changes in longterm inflation differential. Increased inflation thus raises longterm interest rates and leads to a depreciation of the spot rate.

3. A Criticism of the Monetary Model:

A serious criticism of the monetary approach would start from the recognition that PPP does not hold as any direct test will show. Therefore an equation like (6), which explicitly relies on PPP, cannot be derived or expected to hold. This leaves expectations as the only direct link between exchange rates and the monetary sector. The argument returns us to equation (15)' written for convenience in logs:¹

$$(15)' \quad e_t = {}_t\bar{e}_{t+1} - {}_t d_{t+1}$$

where the prefix denotes the time at which expectations are formed and where ${}_t d_{t+1}$ denotes the one period interest differential starting at time t .

We now want to sketch what the implications for empirical testing of an expectations based approach would be. For that purpose we subtract from (15)' last period's exchange rate:²

$$(20) \quad e_{t-1} = {}_{t-1}\bar{e}_{t+1} - {}_{t-1}d_{t+1}$$

¹ Equalizing the expected return from an investment at home and abroad we have the following relation between the dollar returns:

$$(1+r^*)\bar{E}/E = (1+r)$$

where $\bar{E}$ is the exchange rate at which we anticipate to convert foreign exchange earnings. We can rewrite this equation as: $E = \bar{E}(1+r^*)/(1+r)$ or, taking logs, $e = \bar{e} - d$ where $d \equiv \log(1+r)/(1+r^*) \approx r - r^*$.

² For subsequent reference we also define the log of the two period interest rate starting last year: ${}_{t-1}d_{t+1} \equiv {}_{t-1}d_t + {}_{t-1}v_{t+1}$ where ${}_{t-1}v_{t+1}$ is the expected one period rate differential between t and $t+1$, expectations being formed at $t-1$. With these definitions we can define the term $\eta \equiv {}_t d_{t+1} - {}_{t-1}v_{t+1}$ as the unanticipated change in the one-period interest rate. The term $\epsilon_t \equiv {}_t\bar{e}_{t+1} - {}_{t-1}\bar{e}_{t+1}$ represents new information about the future exchange rate.

where ${}_{t-1}d_{t+1}$ is the two period interest differential:

$$(21) \quad e_t = e_{t-1} + (\bar{e}_{t+1} - {}_{t-1}\bar{e}_{t+1}) - {}_t d_{t+1} + {}_{t-1}d_{t+1}$$

$$= e_{t-1} + \varepsilon_t + {}_{t-1}d_t - \eta_t$$

The explanation for our equilibrium exchange rate as written here will rely on the rational use of information. I will argue that today's equilibrium exchange rate is equal to last periods' adjusted for the one-period interest differential that prevailed between last period and this period. The remaining determinants of the exchange rate are white noise or fresh news or unanticipated events. They represent respectively the change in the expected future spot rate between last period and this period, ε_t , and the reassessment of the one period interest differential starting today, that is news about the term structure, η_t .¹

The emphasis on exchange rate movements as embodying new information is of course an essential aspect of assets market theories of the exchange rate. This is particularly recognized in the work by Mussa (1976, 1977).

In this formulation the exchange rate will depreciate today relative to its previous level for one of three reasons:

(a) the depreciation was anticipated and already reflected in the one period interest differential ${}_{t-1}d_t$ which in this case would have been positive.

¹A closely related question, the efficiency of the forward market, has been extensively tested by running regressions of the form $e_t = a_0 + a_1 f_{t-1} + u_t$ where f_{t-1} is the forward rate at $t-1$. The test involves the joint hypothesis of $a_0 = 0$ and $a_1 = 1$. See Levich (1978). The focus of interest here, of course, is that the serially uncorrelated innovations should be explained in terms of a structural model.

(b) There is news about interest rates. The one-period differential, starting today, had been incorrectly predicted and the reassessment of the interest differential leads to a depreciation in the one period rate starting today is above the rate that was implicit in last periods two period differential. An unanticipated increase in interest rates with unchanged expectations about future exchange rates will lead to a appreciation of the spot rate.

(c) The last piece that leads to a change in the exchange rate is news about next periods equilibrium exchange rate. Again here we look solely at a change in expectations due to new information. It is apparent that rationality requires that ϵ and η be serially uncorrelated.¹

¹ Since η_t is observable there may be a temptation to run an equation $e_t = e_{t-1} + \alpha_{t-1} d_t + \eta_t + \epsilon_t$, treating ϵ_t as the error term. The procedure is not appropriate since the revision of interest rates is likely to be correlated with ϵ_t as the case of unanticipated money, for example, makes clear.

This model of the equilibrium exchange rate draws attention to the right variables in an exchange rate equation. The right variables, in addition to the lagged rate and the one period differential and change of differential are the unanticipated components of the variables that systematically affect exchange rates. Thus an unanticipated, permanent increase in money will depreciate the exchange rate in the same proportion if interest rates remain unaffected and more than proportionately if interest rates transitorily decline. A change in the terms of trade, with unchanged price trends and output will immediately depreciate the exchange rate in the same proportion.

From the perspective of the monetary approach this formulation suggests that we need both a structural model that will tell us about longterm determinants of exchange rates and the dynamics of the economy and we need a model of the unanticipated component of the exogeneous variables. The model differs, of course, from the monetary approach since the latter could be written as:

$$(6)'' \quad e_t = e_{t-1} + a_0 \Delta(m-m^*) - a_1 \Delta(y-y^*) + a_2 \Delta(r_S - r_S^*)$$

where the Δ denotes first differences. In contrast to (6)'' we have in (21) the unanticipated components of these first differences but we have in addition other structural determinants of exchange rates as they arise in a world not bound by strict PPP. To implement an equation like (21) the procedure clearly parallels work on interest rates or output determination where the implications of rational expectations have started to be tested.

4. The Portfolio Balance Model

The portfolio balance model has received relatively less attention than the simple monetary model. This is due, in part, to the data requirements and in part to the fact that the theory is less structured

in its predictions. Nevertheless, drawing on work by Branson, Halttunen and Masson (1977) and Porter (1977) we can report some results for the \$/DM exchange rate.

We recall from equation (14)' that the equilibrium exchange rate is determined by relative asset supplies. More particularly, an increase in the ratio of money to domestic assets will lead to a depreciation as will an increase in the ratio of domestic assets to foreign assets. The tests that have been performed have excluded domestic assets entirely and thus focus only on money and net foreign assets where the latter are obtained by cumulating current account surpluses.

In the Branson-Halttunen-Masson (BHM) model the \$/DM exchange rate is estimated for the period 1971:8-1976:12:

$$(22) \quad E = -4.85 - .0618M + .09M^* + .6758F - .3976F^* \quad \text{Rho}=.87 \quad R^2=.94 \quad DW=1.35$$

$$(-.1) \quad (-1.7) \quad (2.8) \quad (1.7) \quad (-1.9)$$

where t-statistics are given in parenthesis, and where M, M*- F and F* denote German and U.S. monimal money stocks and net external assets.

The equation supports the theory in that the coefficients of money and foreign assets have the correct signs. The corresponding elasticities are respectively: -.73, 1.85, .05 and -.22.

These elasticities with respect to money very broadly support a monetary view. The interesting novelty, however, is the inclusion of net foreign assets which here have an unambiguous effect. A current account surplus, by leading to accumulation of external assets, gives rise to an appreciation. This is an important link that had been neglected by earlier asset market views and for which support is therefore all the more important.

I see the chief interest of the portfolio model as a direction of research that moves exchange rate theory away from money and PPP toward a perspective that emphasizes increasingly real variables: relative asset supplies, exchange rate expectations, the terms of trade and the current account.

5. The Impact of Traded Goods Price Movements

In this section we study briefly the impact that movements in traded goods prices exert on the economy. Two questions concern us here. One is the extent to which an increase in import prices increases consumer prices and the GNP deflator. That question is important because it measures the inflationary impact of exchange depreciation as brought about, for example, by expansionary monetary policy. The second question concerns the responsiveness of trade flows to relative price changes. That question is of interest because it measures the extent to which depreciation induced movements in competitiveness create net exports and thus aggregate demand. Both questions are essential aspects of the dynamic extension of the Mundell-Fleming model in section 5 above.

i. The Inflationary Impact of Import Prices:

An exchange rate depreciation will, for given world prices raise the domestic price of imports. There is thus a direct impact on consumer prices to the extent that the CPI includes importables. There are additional effects, however, to the extent that prices of closely competing goods will tend to rise. Finally there may be a more time consuming adjustment as money wages rise in response to the induced

CPI inflation. We have tried to capture all these effects in a rough way by a price equation that relates the rate of CPI and GNP deflator inflation to their own lagged levels, the prime male unemployment, u , rate and import price inflation, P_m . Table 4 summarizes these results; using U.S. quarterly data for 1965/I-1977/IV:

Table 4: THE IMPACT OF IMPORT PRICE INFLATION IN THE US

Price Index	const	P_{-1}	$1/u$	P_m	R^2	DW
CPI	.002 (.003)	.43 (.14)	.007 (.005)	.15 (.03)	.64	1.92
GNP Deflator	.004 (.002)	.40 (.10)	.004 (.003)	.15 (.02)	.78	1.96

Note: The inflation rates on the right hand side are one year moving averages. Standard errors in parenthesis.

The equations strongly support the idea that an increase in import prices spills over into increased domestic inflation. In the shortrun an increase in import price inflation of two percentage points will raise domestic inflation by about a third of one percent. The longrun effect is about double that figure. It is perhaps interesting to note that the magnitude of the short and longrun effects of import prices substantially exceed the share of imports in GNP or expenditure and thus demonstrate that there is substantial spillover.

The impact of import prices on domestic prices can thus be determined with considerable accuracy. The harder question is the impact of depreciation on import prices. Here we have substantial differences across commodities. A reasonable approximation would be to assume that an across the board one percent depreciation in the effective exchange rate would raise import prices by between a third and a half percentage

point. The difference is made up in part by a decline in prices abroad and in part by a reduction in foreign profit margins.

If we combine these numbers with those in Table 1 we conclude that a five percentage point depreciation in the effective exchange rate would in the shortrun raise inflation by about four tenths of a percent and in the longrun by about double that amount. For the US there is thus clearly an inflationary impact but it really is not very substantial in magnitude.

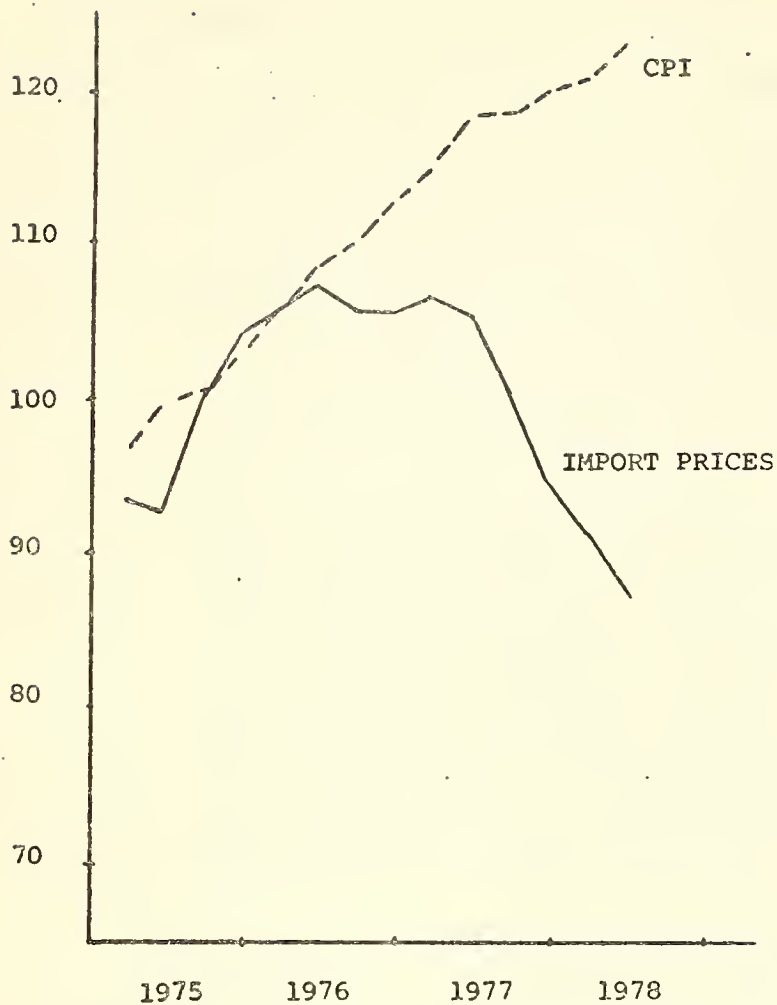
The experience of Germany, Switzerland or Japan is of course quite different. With substantially more open economies import prices exert a more sizeable effect on domestic prices. Accordingly the large appreciations which these countries have experienced have made a large contribution toward stabilization of inflation. Table 5 shows inflation rates of consumer and import prices for these countries. Chart 3 looks at the case of Japan. With import prices actually declining there is a powerful check on domestic wage and price movements and thus a possibility of reducing inflation without a major recession.

TABLE 5: DOMESTIC AND IMPORT PRICE INFLATION

	GERMANY		SWITZERLAND		JAPAN	
	Domestic	Import	Domestic	Import	Domestic	Import
1975	5.9	-1.7	6.7	-9.8	11.9	7.6
1976	4.5	6.7	1.7	0.4	9.3	6.0
1977	3.9	1.5	1.3	1.2	8.1	-4.2
1977/78	2.7	-6.5	1.4	-10.0	3.6	-17.0

Note: Domestic inflation is measured by the CPI. The 1977/78 data correspond to the period 1977/II to 1978/II.

Source: International Financial Statistics and Federal Reserve Bank of St. Louis.



Source: International Financial Statistics

CHART 3 CONSUMER PRICES AND IMPORT PRICES IN JAPAN
(1975 = 100)

ii. The Responsiveness of Trade Flows:

To complete our framework of reference we briefly look at the responsiveness of trade flows to changes in relative prices. We noted earlier that an expansionary monetary policy will depreciate the exchange rate and thus change relative prices. We now ask how much of a change in net exports can be expected. There is of course a wide body of empirical studies to draw on. We limit ourselves here to some recent estimates by Deppler and Ripley (1978), Goldstein and Khan (1978) and Hooper (1978).

Table 6 summarizes the elasticities with respect to relative prices that emerge from these studies for the case of the US:

Table 6: TRADE ELASTICITIES

	Shortrun	Cumulative
<u>EXPORT DEMAND</u>		
<u>Total:</u> a.	--	-2.32
b.	-1.26	-2.12
<u>Manufactures:</u>	-0.29	-1.52
<u>IMPORT DEMAND</u>		
<u>Manufactures:</u>	--	1.92
<u>Total Non-Oil:</u>	--	.92- 1.15

Note: On the export side estimates a. and b. are from Goldstein and Khan (1978). The estimates for manufactured goods are from Deppler and Ripley (1978). The shortrun for the former is a quarter, for the latter a year. The non-oil import elasticity estimates are from Hooper (1978) using equations without a time trend.

The table reveals two by now well established facts. First, that there is substantial longrun adjustment to relative price changes. The cumulative response of world demand to a reduction of five percent in the relative price of US export goods is about ten percent. Similarly on the import side we have evidence for substantial elasticities in the longrun response.

The second fact concerns adjustment lags. These lags are very pronounced as can be seen from the difference between shortrun and longrun elasticities. The exact time shape of the response is very hard to determine with any precision but can readily be summarized by saying that full adjustment is a matter of years, not quarters.

The evidence then suggests that a reduction in the relative price of US goods will increase net exports and thus improve the current account and add to demand. In this direction there is some compensation for the inflationary effect of monetary policy through increased prices. It is important to recognize, though, that the trade adjustment is slow and that accordingly this channel of monetary policy may be a poor instrument of cyclical stabilization policy.

III. CONCLUDING OBSERVATIONS

The theoretical framework and the empirical evidence allow us to form some tentative conclusions about the determination of exchange rates and the scope for monetary policy under flexible rates. The conclusions must remain tentative because the theory itself remains very much in flux - much as the domestic counterpart in macroeconomics, and because the empirical evidence is only starting to come in and to receive proper scrutiny.

With these caveats in mind here are some conclusions:

A first conclusion must concern the "right" model of exchange rate determination. I take the evidence, theoretical and empirical, to reject the monetary approach in the narrow way in which it has been empirically implemented. The portfolio approach is important because it draws attention to the current account but the empirical work remains largely to be done. My own preference remains with an extended Mundell-Fleming model that recognizes the determination of exchange rates in assets markets, the differential speeds of adjustment of assets and goods markets and the central role of expectations of the future exchange rate in influencing the current rate. PPP in this model is a longrun tendency, although of course the terms of trade may have to change secularly to accomodate biased growth patterns. Given such a framework, what are our conclusions about monetary policy?

(i) Monetary policy under flexible rates and high capital mobility works not only by affecting the interest sensitive components of aggregate demand but also by increasing net exports. Expansionary monetary policy will depreciate the exchange rate and thereby, at least temporarily, improve our competitiveness.

(ii) Will expansionary monetary policy improve the current account?

The gain in competitiveness that is at least transitorily gained by an expansionary monetary policy will no doubt by itself improve net exports and thus add to aggregate demand. There is, however, a potentially offsetting increase in imports arising from the domestic expansion in demand due to lower interest rates and thus higher investment and consumption spending. The net effect on the current account remains uncertain since it depends on the relative magnitudes of the decline in interest rates and the response of aggregate demand to interest rates and the composition of spending to relative prices. It is certainly not a foregone conclusion (except when interest rates cannot at all decline from the world level) that monetary expansion and depreciation must improve the current account. To the extent, though, that the interest rate effects in the first place affect construction one would not expect the adverse absorption effects on the current account to arise early compared to the relative price effects.

(iii) Monetary policy has an immediate effect on exchange rates.

A change in the nominal quantity of money in the shortrun is a change in the real quantity of money which will bring about a change in interest rates. With changed interest rates and unchanged expectations spot rates have to move to maintain yields in line internationally. If monetary policy affects exchange rate expectations then the exchange rate adjustments have to be even more pronounced.

(iv) The instability or volatility of exchange rates arises from two sources. The first is the very low interest elasticity of money demand which implies that fluctuations in the demand or supply of money produce large fluctuations in interest rates and therefore require large movements in exchange rates to maintain yields internationally. The second source is instability in the exogeneous variables--there is plenty of news.

(v) Movements in exchange rates affect the level of import prices directly and spill over into consumer, wholesale and producer prices. The extent and speed of this spillover is an essential question from the perspective of monetary policy. While the increase in import prices is helpful in establishing a gain in competitiveness it of course hurts from a point of view of inflation. The more rapid and the more substantial the spillover of import prices into domestic prices the more inflationary is monetary policy and the less effective it is with respect to aggregate demand.

(vi) The empirical evidence indicates that the changes in real exchange rates and competitiveness induced by nominal exchange rate

movements persist for a considerable length of time. The reaction of trade flows and direct investment to these changes in relative prices are, however, slow to come about so that the net export channel cannot be counted upon as one of the more rapid responses to monetary policy.

Having reviewed in a broad manner the implications of theory and evidence for the role of monetary policy under flexible rates we conclude with another aspect of the same question: to what extent do monetary factors account for the ongoing depreciation of the dollar? There is a worrying temptation, in this connection, to look to monetary factors as the dominant explanation. Thus the Wall Street Journal in a continuing public education effort has reminded us once more:

"...And surely the price of the dollar depends on supply and demand for the dollar. It declines because the Federal Reserve supplies more dollars than are demanded. For all the talk of swap networks, gold sales and so on, the only way the decline will be reversed is for the Fed to constrict the supply of dollars."¹

Table 7 summarizes monetary growth rates for M_1 for some of the major industrialized countries and the US. The table also shows the behavior of the effective dollar exchange rate. Note that for the last five quarters the dollar has been depreciating, although US monetary growth has been among the lowest. Note in particular German monetary growth which surely must be reckoned high. No doubt the lesson of the monetary approach--the exchange rate is the relative price of two moneys--must have been overlooked.

¹ See Wall Street Journal, August 30, 1978 "The Counsel of Surrender".

TABLE 7: MONETARY GROWTH AND DEPRECIATION

(% Annual Rates)

	MONETARY GROWTH				EFFECTIVE \$ RATE
	Germany	Japan	UK	US	
1976	10.3	14.2	11.4	5.1	-5.0
1977	8.3	7.0	21.5	7.1	1.1
1977 I	12.6	4.2	13.4	7.2	-
II	6.0	-3.0	15.9	8.6	2.7
III	12.7	16.9	29.5	8.3	2.7
IV	10.3	7.0	29.7	7.7	10.0
1978 I	25.3	9.7	17.3	6.3	13.2
II	6.5	13.2	n.a.	10.3	5.7

Note: The quarterly data show quarter to quarter changes at annual rates. The last column shows the annual rates of change of the effective dollar exchange rate. A minus sign indicates an appreciation of the dollar.

Source: Federal Reserve Bank of St. Louis, International Financial Statistics and OECD Economic Outlook.

If monetary factors do not account for the full extent of the depreciation what factors should we look to for an explanation? Of course we should remember that real factors do have an impact on exchange rates. Suppose a given trend of monetary policies in the US and abroad and therefore a given trend of prices. Suppose now that a current account deficit arises and that there is no expectation that it will close in the near future of itself. A change in the terms of trade will be required to restore competitiveness and thus help achieve full employment current account balance. A deterioration of our terms of trade, of course, with a given path of prices will require a depreciation of the exchange rate.

Now let me argue why I believe this story to be the major explanation for the dollar depreciation. I see two main reasons for

a "structural" U.S. current account deficit. One is the medium-term reduced growth rates in other industrialized countries, in particular Japan and Germany. This implies that with unchanged U.S. growth (I take it a 3.5-4% growth path will be maintained) and given the evidence on U.S. and foreign income elasticities in trade there will be continuing if not growing imbalance.

The second and possibly more important reason is the growing competitiveness of LDCs in manufacturing trade. These countries have achieved substantial industrialization in their domestic markets and have to look to the world market for continuing growth. They have already shown impressive performance in the U.S. market as evidenced by the fact that their share in our manufactured imports in the last five years has risen from 15% to more than 20%. I suspect that this trend will be substantially accelerated as the large European and Japanese direct investment in these countries starts to bear fruit. The U.S. market will increasingly prove to be the testing ground for newcomer's export drives. The resulting effect for our current account is unquestionably a deterioration unless we manage to outpace with new products and innovations the rate at which the rest of the world imitates U.S. techniques.

At present there is no evidence of a restructuring of the economy toward a dynamic, trade oriented stance. Accordingly there is no surprise that the market should anticipate deteriorating terms of trade and ongoing depreciation. The anticipation of course translates into an immediate depreciation. The depreciation presents, of course, a conflict. It is directly and immediately inflationary and to that extent interferes seriously with an attempt to contain inflation. At the same time, though, it contributes to a restoration of U.S. competitiveness and thus helps

maintain or increase aggregate demand. Since the medium term deterioration in the terms of trade is largely inevitable it is important not to interfere with the depreciation but rather to concentrate on a more basic macroeconomic reorientation toward fiscal restraint for an improvement in the current account combined with monetary and fiscal policies conducive to investment and growth.

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